Sections of this and the Traverse region of Michigan are still sparsely settled, or not at all, and have been visited rarely by botanists. Consequently, we may expect many editions to our flora, as well as corrections, when this region is as thoroughly known as the south half of the State now is; our ignorance, rather than nature's parsimony, explaining why we have so few species credited to us. The most promising field for the botanist evidently lies in the Houghton Lake region and northward, and in the upper Peninsula, many parts of the interior of which are botanically unknown.

Our flora, as here presented, contains in all 113 families (orders), and 1,634 species. The composites claim the largest number of species, 182—about one-ninth of all. Sedges follow with 176 species; grasses, 139; rosaceæ, 61; ferns, 56; leguminosæ, 55; figworts, 46; mints, 40; mustard and crowfoot, 39 each; heath family, 35; and umbelliferæ, 27. We have 165 trees and shrubs, about 20 of which are valuable timber trees. At least 40 of our trees and shrubs are worthy of cultivation for ornament. Sugar maples and elms are commonly planted, while the tulip tree, basswood, Kentucky coffee tree, black walnut, and butternut, among deciduous trees, and hemlock, white pine, black spruce, arbor vitæ, and red cedar, among evergreens, deserve more attention. About 20 species of woody and herbaceous native climbers are frequent, and some are worthy of cultivation, (see State Pomological Report of '79 for a list.) Ninety medicinal plants are admitted into the U. S. Pharmacopœia, 45 belonging to the primary list, and an equal number to the secondary, while a number of others deserve attention at the hands of Pharmacists.

It may be stated in conclusion that, in the preparation of this catalogue, we have spared no pains to make it thoroughly reliable, a majority of the species enumerated having passed through our hands, and the remainder being admitted only on good authority. We have preferred to make a *useful* rather than a a *large* catalogue, and, on this ground, we have rejected a number of species, some of which may yet make good their claim to be considered as part of our flora. We cannot hope to have escaped all errors, and crave charitable judgment for any such the kind reader may discover, trusting that they may be found errors of omission rather than of commission.

In our arrangement of orders, we have preferred, as more convenient, to follow the 5th edition of Gray's Manual rather than later works. The vexatious subject of synonomy has received considerable attention, and will, we believe, be found brought down nearly to date. Further observations will be published from time to time in the form of addenda, towards increase of which we solicit correspondence and contributions from all parts of the State.

IONIA, MICH., January 20, 1881.

DISRUPTION OF PLANETARY MASSES FROM THE PRIMEVAL NEBULA.

V.

BY EDGAR L. LARKIN.

It has been shown in this series that the gaseous sphere could not have parted with any form of ring known to geometers. All varieties of segmental rings were examined, and their displacement found impossible by known laws of mechanics. The nebula subsided from space to the dimensions of the orbit of Neptune, else its assumed rotation could not have been equal to the orbital velocity of that planet.

Indeed, it must have revolved faster, for matter along the line of the centre of gravity of the ring moved with the rate that Neptune now has. Then the outside of the ring moved faster and the inside slower than the Neptunian velocity. But the inside was required to move with greater rapidity than any other point to exceed attraction and disrupt the mass. From this consideration alone the doctrine of ring detachment is subverted.

We are now to demonstrate that no particle whatever can be detached from a revolving sphere whether gaseous, fluid or solid, by any force known to man. Tangental force in no case overcomes radial, being unable from known physical laws, which teach that not an atom ever left a rotating cosmical mass. We have made calculation of the maximum effect ot tangental force on matter on the equator of the sphere when coincident with the orbit of Neptune, radius being 2,780,000,000 miles. And if the solar parallax is modified, bringing Neptune somewhat nearer, the figures will not be in material error. It is a law of mechanics that if matter is thrown off the periphery of a revolving sphere by force evolved by rotation, the detached portion always, when maximum power is exerted, traverses a line tangent to the curvature at the point of departure. If a revolving globe should burst, the pieces would be projected along tangental lines and never rise higher. But what is a tangent to the Neptunian orbit, and what is its departure from the curvature of that mighty sphere whence Neptune's mass is said to have been detached? It is apostulate of the Hypothesis that the nebula was a sphere, else it could not have parted with matter in the form of a ring. We adopt the idea that it was round, and for the purposes of trigonometry imagine the surface to have been as level as still water. We are in search of the departure of the tangent from the curve at different distances along the equator, to learn how far tangental force was able to project matter above the periphery.

The length of 1″ of arc on the equator of the nebula was 13,478 miles, and we made selection of 8″ of arc or 107,824 miles to find the amount of its deflection from the tangent. The curvature cannot be detected by tables of logarithmic functions carried to the sixth decimal place—thus:

log. sin. 1′	=	6.463726
log. 60	=	1.778151
log. sin. 1″	=	4.685575
log. 8	=	.903090
log. sin. 8″	=	5.588665
and		
log. tan. 1″	=	4.685575
log. 8	=	.903090
log. tan. 8″	=	5.588665

That is, the logarithmic sine and tangent of 8″ are the same; hence the arc cannot be told from a straight line by ordinary tables. This being the case, radii drawn to the centre from each extremity would be equal in length, and it follows that any particle of matter on the equator of the primeval sphere, after having traversed more than a hundred thousand miles under the influence of tangental force, was no further from the centre than when it started, making the formation of a ring, or detachment of an atom, alike impossible.

Not deeming it true that an arc of such length had no curvature, and not having logarithmic tables for exact computation of functions near their limits, we were obliged to use the cumbersome method of natural sines, cosines and tangents, carrying the calculation to the twentieth decimal place to secure accuracy.

To find the cosines of such minute arcs use was made of the formula—Cos.$=1-\frac{1}{2}$ sin.^{2}, and for secants—Sec. A$=\frac{1}{\text{cos.}}$A.

Applying these formulæ to the arc of 8″ it was found that the secant was only 1.94 miles longer than the radius. That is, the curvature of the sphere at any point distant 107,824 miles from another, made a point of tangency, is less than two miles! Let us watch the career of an atom destined to be cast off the equator to

become a part of the Neptunian ring. Conceive the sphere at rest; let some unknown law cause it to rotate, with constantly accelerating velocity, until finally equatorial atoms are moving so fast that tangental force just counteracts gravity. The particles will be balanced and without weight. Increase rotation, and the atoms will move on a tangent instead of the surface of the sphere.

But they had to move 50,000 miles before it could be determined whether they were traversing the periphery or tangent, and over 50,000 more miles in order to attain an elevation of two miles! To do this the maximum force was required, as it alone was able to project matter to the tangent.

Nothing in nature can exceed the feebleness of this maximum tangental force. An atom on the equator required 8h. 54m. to traverse 107,000 miles, and then it was not quite two miles further from the centre. Yet this gentle force cast off a ring whose mass was 102 sextillion tons, if the Hypothesis is true.

No theory ever advocated concerning the development of the planets has so little in its favor as that of ring detachment. Below is a table showing the increase of distance of equatorial atoms from the centre of the sphere after having traversed different arcs from the point where they became balanced between the opposing forces, centripetal and tangental.

The first column gives the arcs, the second their length in miles, and the third shows the gain in distance from the centre of the nebula, after reaching the extremity of arcs, providing the matter touched the tangents.

Arcs.	Length in Miles.	Altitudes of Matter in Miles.
8″	107,824	1.94
10″	134,780	2.78
15″	202,170	7.
25″	336,950	20.
1′	808,671	117.
10′	8,086,710	11,759.
1°	48,520,266	417,061.

But no atom could rise above the periphery, for the entire periphery itself would rise. Thus, let a particle become subject to tangental force and fly along a tangent. Let the force be enormous, sufficient to hurl equatorial matter along a tangent of 1° or 48,520,666 miles, and it will then be 417.061 miles more distant from the centre. The next atom behind would follow and all others on the same line around the sphere. The next inner particle would become elevated, and the next until the space 417,061 miles filled with gas, the result of the process being that the equatorial diameter of the nebula increased 834.122 miles. But this diminished rotation allowed gravity to regain dominion and bring down the protuberance to a level as before. This mutation must obtain in all rotating masses so long as they remain gas or liquid, the areolar velocity being a constant. During the ascent and fall of the equatorial matter it is seen that no particle wandered away, but every one returned at the command of gravity. When a mass solidifies its rotary velocity cannot accelerate, and since matter is unable to part from a fluid sphere it cannot possibly leave a solid. Hence no cosmical mass, whatever its size, density or rate of revolution, ever detached an atom by force generated by rotary motion. Suppose the nebula received an impulse that imparted inconceivable velocity of revolution, causing peripheral matter to rush on a tangent of 20°, flattening the mass into the shape of a bi-convex lens, then rotation must have almost ceased, when gravity reasserted mastery. Let one imagine himself to have been placed on the equator of the nebula, assuming the gas visible, which was not the case. An ordinary tree could then be seen with a telescope at a distance of 50.000 miles! The top of a common terrestrial mountain would have been in sight at a distance of more than 100,000 miles! The observer would have found himself in the midst of a mighty plain, and would have been able to see mountains a hundred thousand miles in every direction, so slight was the curvature. At a distance of 1° or 48,000,000 miles the depression below a tangent was only 417,000 miles. The diameter of the sun is 852,000 miles; therefore, if it were placed on the circumference of the primeval sphere, its semi-diameter could be seen at that enormous distance. Reverse nature's laws, making it possible that tangental force can disrupt a revolving mass, then with the sphere's known rotation of 3.36 miles per second (admitting the Hypothesis true) could a ring have been abandoned? Could the rotary motion even cause currents to flow from the latitudes to the equator, or even produce an equatorial elevation in so vast a level capable of detection by some distant micrometer? We answer no, because Neptune, with the same velocity, keeps on its orbit. We fail to see why the theory of ring displacement was ever entertained, since no analogy in nature suggests it.

New Windsor Obs., *Aug.* 8, 1881.

MICROSCOPICAL TECHNOLOGY.

Dr. Carl Seiler's Methods.

MOUNTING.

For mounting, both resinous and aqueous solutions may be used, which each possess advantages over the other, and for this reason a controversy has been going on for some time, between eminent microscopists, in regard to the advantages of glycerine, on the one hand, representing the aqueous mounting media and balsam, on the other, representing the resinous class. The truth is, that both should be used, as occasion requires. Glycerine, or its equivalents, should be used when it is desired to bring out delicate striæ, lines, hair-like projections, such as cilia on the epithelium of the respiratory tract, processes of the ganglionic nerve cells, and so forth, and for delicate vegetable preparations. Balsam should be used when clearness and transparency of the object, and brilliancy as well as durability of the staining is desired.

In order to clearly understand this the student will do well to mount two preparations of the same tissue, the one in balsam, or other resinous medium, and the other in glycerine or its equivalent, and then compare the results. He will find that the one medium is better suited for a particular preparation than the other.

Balsam. Among all resinous substances Canada balsam is the best for mounting purposes, provided it has been properly prepared. To do this, take a clear sample of balsam and evaporate it in a water bath, to dryness, that is, until, when hot, all odor of turpentine has disappeared, and, when cold, it is hard and brittle, like resin. This will take several days; and great care should be exercised in keeping the water bath full of water, for as soon as the temperature in the balsam is raised above 212° F. it turns brown, and is then unfit for use.

When thus evaporated the balsam is again heated in the water bath and enough of Squibb's absolute alcohol is added to dissolve it and make the solution of the consistency of thin syrup. It is now allowed to cool and poured into a spirit lamp, the wick having been removed, in which it is kept for use, the glass cap of the lamp protecting it from dust and preventing the evaporation of the alcohol. If, after using for some time, the solution becomes too thick, it should be warmed by placing the spirit lamp in warm water and adding to it some warm absolute alcohol. If the alcohol used in dissolving the balsam or in diluting the solution is not strong enough, a white precipitate will form, which may be redissolved by the application of heat, but will reappear when exposed to the air, in a thin layer on the